INSTRUCTOR INFLUENCE ON SUBSEQUENT STUDENT PROGRESS IN A PHYSICAL SCIENCE COURSE

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CHAPTER 1

INTRODUCTION

The purpose of this study is to investigate the relation between instructors and the subsequent performance of their students.

Many instructors believe that they have some influence on their students, and that this influence is not limited to what goes on while a student is enrolled in a particular course that is being taught by the instructor at a particular time. Rather, teachers feel that their influence on students, or on some students at least, is more enduring. That is, it should be possible to find a relation between the instructor a student had in one situation and the behavior of the student in a subsequent situation that involves the same or similar subject matter. In the present investigation, the hypothesis that there is such a relation will be tested.

History

The influence of instructors on their students has been studied generally in the context of measurement of teaching efficiency. Many educators have felt that a good teacher produces changes in his students. Thus, the relative efficiency of a teacher could be determined by comparing the achievements of the pupils of that teacher with the achievements of the pupils of other teachers.

An early advocate of this view was Davidson (23), who in 1913 said, "It is obvious that, as the tree is to be judged by its fruits, so the teacher is to be judged by the effects he produces in the pupils of his class" (23, p. 286).

Davidson was proposing that the effects produced in students be taken into account in the supervisory ratings of the teachers of the students. Kent (39) made a similar proposal in 1920.

Several methods have been used in the attempt to differentiate teachers on the basis of student performance. A simple technique is to compare teachers on the basis of the performance of their pupils, without any correction for factors other than the teacher which may be related to the pupils' performance. This technique was used by Davis (24). Davis obtained raw scores of high school pupils on the Minnesota State Board Tests and changed these scores to McCall T scores. He then found for individual teachers means, computed on the basis of the first ten pupils allocated alphabetically to a teacher. Thus, teachers could be compared with each other on the basis of the mean T scores of their students.

A similar method can be called the "raw gain" method. A pretest in some subject area is administered to the students of several teachers. Teaching occurs, and then a post-test is administered to the students in the same subject area. Often, of course, the pretest and the post-test are actually the same test given before, and after, teaching, respectively. In this method, the amount of gain made by the students between the pretest and the post-test is taken as an index of the influence of the students' teachers. The gain is not corrected for extraneous factors.

The raw gain method has been used by Courtis (19), by Hill (35), by Brookover (15), and by Barr et al. (6). Courtis illustrated the method by showing the relatively large gain made in arithmetic by the class of a supervisor in Detroit. Hill (35) measured gain in penmanship, spelling, and arithmetic; and Brookover (15) in history examination scores. Barr et al. (6) used this method in conjunction with other methods.

Hill found a coefficient of correlation of .45 between the gain made by teachers' students and supervisory ratings of the teachers. Brookover (15) found negative, curvilinear, and zero relations between gains made by pupils and the pupils' ratings of their teachers. The mean gains of teachers' pupils appeared related to the teachers' age and marital status, but not to the size of the high school nor to the size of the class. Student gains were greater for teachers who were married and who were aged twenty-seven to thirty-eight.

Cheydleur (17, 18), studying college instructors of French, made use of a raw gain criterion of teaching efficiency and of two other criteria also. These three criteria were:

1. The number of times the means of the final examination marks of the instructor's classes fall above or below the average for the group of instructors.

2. The number of times the difference between the standard deviation of the class marks and the standard deviation of the departmental examination marks of the instructor's classes is less than the difference of the standard deviations for the group.

3. The number of times the instructor's coefficients of correlation between his students' class marks and their examination marks exceed similar coefficients of correlation for the group.

The second criterion assumes that a "good" instructor will identify with his class marks a wide range of talent in his students, and the third criterion assumes that he will identify this talent accurately (vide 17).

The above-mentioned studies were concerned with gain in knowledge. Bowden (12), on the other hand, attempted to find change in attitudes. He administered the Allport-Vernon Study of Values at the beginning of and at the end of a course in social psychology, and determined the amount of change in each of the six values. The results showed that the "social" values were neither reduced to nor elevated to the test norms during the course of the year.

Fersh (27) studied change of attitudes in a social science course at New York University. He administered to students of four teachers pretests and post-tests of social beliefs, social values, and interpretation of data. During the course, students' values and beliefs seemed to change in ways suggested by the goals of the course. Social beliefs tended to become more "liberal," more certain, and more consistent; social values tended to become more "liberal" and more certain; and interpretation of data tended to become more accurate. The four instructors were ranked on the basis of these changes in their students. The instructors were also given the tests, and there seemed to be some association between an instructor's own standing in "liberalism" and in consistency and his students' gains in these factors.

Finally, two indices of teacher efficiency based on raw gain have been suggested. Day (25) proposed an index called the T. Q. (Teaching Quotient) based on the ratio of the obtained class score of a student to the standard score for that grade. Georges (31) suggested that instructional efficiency is the ratio of actual increase in learning to the maximum increase possible.

The raw gain method, however, has a serious disadvantage. It does not take into account factors other than the present teacher that may influence the amount of student achievement.

One factor **that** may be related to a student's achievement is his intelligence. Several investigators have tried to correct achievement for intelligence by means of an "accomplishment quotient," which is obtained by dividing a measure of a student's achievement by a measure of the student's intelligence.

The concept of the accomplishment quotient is attributed to Franzen (28), who proposed such a measure as an ideal school mark in 1920.

Crabbs (22) used change in the accomplishment quotient (A. Q.) or accomplishment ratio (A. R.) as a measure of teacher efficiency. She defined A. R. or A. Q. as:

$$(\text{subject age}/\text{mental age}) \times 100$$

Teaching efficiency is the final A. R. minus the initial A. R. The subjects under consideration were reading, arithmetic, spelling, composition, and penmanship; a student's initial "subject age" and final "subject age" were obtained from his initial and final scores on achievement tests by means of tables in the manuals accompanying the tests. A student's initial mental age was estimated from the National Intelligence Test, and his final mental age was extrapolated from his initial mental age. The mean change of students in A. R. was obtained for each teacher. Also, a composite mean A. R. was constructed by weighting each mean A. R. in accordance with estimates made by judges as to the relative worth of the various subject matter areas.

Change in students' A. Q. as a measure of instructional influence has been used also by Coy (21) and by Barr et al. (6). Barr et al. found no relation between gain in students' A. Q. and ratings of the students' teachers.

Bimson (10) introduced a modification of the A. Q. called the "progress quotient." The progress quotient is the student's progress during one semester as measured by his scores on standardized tests divided by the student's intelligence quotient.

A similar modification was used by Stephens and Lichtenstein (64); they obtained the "individual efficiency" of a student by dividing the difference between final and initial "educational age" by initial mental age. "Class efficiency" was the mean individual efficiency of the class. These investigators found a positive relation between class efficiency and "experience" for younger teachers, and a negative relation between class efficiency and "maturity" for older teachers. These were teachers of fifth grade arithmetic.

There are several possible objections to gain in accomplishment ratio as a measure of instructional efficiency. For one thing, Chapman (16) presented a formula that shows that the reliability of differences in A. Q. would be expected to be low. Chapman also pointed out that achievement tests themselves can be considered intelligence tests if it is assumed that "the amount learned, or facility acquired, from the experiences afforded by a fairly uniform environment gives the most reliable estimate of intelligence." (16, p. 103).

Further, Symonds (66) noted that achievement tests measure only the mechanical aspects of education. Symonds noted also that some school subjects may not correlate highly with intelligence, and that scores in such subjects would not be corrected for initial ability by a correction for intelligence.

Coy (21) found that students with low initial A. Q. tended to have higher A. Q. on retest while students with high initial A. Q. tended to have lower A. Q. on retest. She found too that students with higher intelligence quotients tended to have lower A. Q. She concluded that teachers with a class of high intelligence and low initial A. Q. probably have some advantage.

Evans (26) indicated two other difficulties with the A. Q. method: students differ in rates of growth and children learn things in places other than school.

Finally, Mitzel and Gross (48) said the major objection to the A. Q. is the loss of information involved. Too much information is surrendered when pupils' raw scores are exchanged for an age equivalent ratio.

In short, the A. Q. has not proven to be a satisfactory measure of instructors' influence.

A number of other procedures has been employed in an attempt to control extraneous factors related to student achievement; some of these procedures will be considered next.

One technique is to match students on extraneous factors so that the relation between instructors and the behavior of their students can be examined more directly. Such a technique is, of course, more applicable to laboratory experiments than to actual conditions.

Jayne (37) matched ten classes on grade placement, initial scores on an achievement test, intelligence, and scores on a reading test. Under these conditions, he found that none of the twelve teaching activities observed was related to the gains of the teachers' students in achievement.

Seyfert and Tyndal (60) matched students of two teachers ("A" and "Z") on age and intelligence. The students of "A" performed significantly better on the Ruch-Popenoe General Science Test and on the Rulon Science Test. In another study with "A" and "Z" it was found that when students were matched on Rulon Science Test score and age, a student of "A" would do as well as a student of "Z" who has three more months of mental age.

Bolton (11) matched high school students of different teachers on sex, intelligence, and vocabulary; and compared groups of students on performance on a test in United States history.

Hartmann (33) measured change of attitudes in a course in educational psychology in which sections were taught by three different instructors. Five attitude tests were administered initially, and students were matched on the basis of these pretest scores; students were matched separately for each of the five tests and for each pair of instructors.

At the end of the course, post-tests were given, and instructors were compared on students' gains on the five tests and on students' grade on the final examination of the course. In regard to final examination grades, students were matched on intelligence and on an initial score on the examination obtained at the beginning of the year.

The actual efficiency scores received by teachers were obtained by a complicated procedure, but the outcome was that the three teachers could be ranked on the basis of the results of the several comparisons.

Hartmann also made use of a somewhat different criterion of teacher efficiency. He assumed that the more efficient is the teacher, the higher will be the relation between students' intelligence and students' achievement in a course taught by the teacher. Accordingly, for each of his three teachers, Hartmann computed the coefficient of correlation between students' intelligence test scores and their final examination scores. He further obtained student ratings of the three instructors. Instructors were ranked on the two criteria, and it was found that the ranks based on the criterion of magnitude of coefficient of correlation between intelligence and achievement were the reverse of the ranks based on the criterion of student ratings.

Besides matching, various other techniques for controlling the influence of extraneous factors on students' scores have been utilized by different investigators. Some of these procedures will be examined next.

McCall (45) combined mean gain scores of classes in several achievement tests, and then adjusted these composite scores of classes for initial score in the achievement tests and for size of class. Bonuses were given to classes with lower initial scores and to larger classes. Seventy-three teachers were studied, and the coefficients of correlation between the composite class gain scores and other instructional measures varied from about +.3 to about -.3. There was a relation neither between class gains and teachers' experience nor between class gains and teachers' age.

Moss _et_ _al_. (54) studied the relation between teachers and grades obtained by their students on a chemistry test at the end of a first year college course. The class medians on the chemistry test were corrected for the intelligence of the students and for whether or not the students had had high school chemistry. The investigors found a tendency for teacher efficiency to decrease for classes with more than thirty or forty students. There was little relation between students' chemistry scores and rank or degree of their instructors, but instructional proficiency seemed to decrease after eleven years of teaching.

Baird and Bates (3) report that the Research Department of the Detroit Board of Education had prepared tables to show "growth ratings" for gains in students' reading achievement. The growth ratings were presented separately for each grade and for each of three levels of student intelligence. Thus, teachers could be compared on the basis of students' growth ratings, corrected for grade and for intelligence.

Baird and Bates found low but significant, positive correlations between the growth ratings of pupils and the supervisory ratings of their teachers.

Brookover (15), as noted above, made no attempt to control extraneous factors, but he found that there were no significant differences between classes on the basis of pupils' pretest scores in history.

Courtis (20) proposed rate of growth as a measure of the effect of teaching. "To secure a 'single variable' measure of teaching, it is only necessary to measure the change in the rate of growth which takes place when change in amount or quality of teaching is the only variable in which change occurs" (20, p. 54). Courtis's developmental curve is represented by Gompertz's formula for biological growth.

Courtis compared two student-teachers judged by the department to be "very good" and "very poor" respectively. A fifth grade class served as experimental subjects for one week. On Monday, Tuesday, and Thursday, they were given study sheets for spelling; but on Wednesday they were taught spelling by the "poor" teacher and on Friday by the "good" teacher. They were given a spelling test at the end of the lesson each day. The results showed that the rate of growth of correct spelling decreased on Wednesday and increased on Friday.

Certain other methods of dealing with student gains involve correlation or regression; these will be examined next.

Taylor (67) studied the relation between teachers and student gain, using partial correlation to hold extraneous factors constant. First, by multiple regression Taylor predicted mean class gain in arithmetic (and in reading) from class over-ageness, class intelligence, initial score of class in arithmetic (or in reading), and supervisory ratings of the teacher. Then, by partial correlation from multiple correlation, each of these four variables (over-ageness, intelligence, initial score, and ratings) was related to final standing in arithmetic (or in reading), independently of the other three variables. Initial ability of the pupils in reading was the best predictor of final standing in reading, while student intelligence was the best predictor of final standing in arithmetic.

Also, students' progress in reading was less related to supervisory ratings of their teachers than was students' progress in arithmetic; Taylor suggested that perhaps the difference between arithmetic and reading is that more "drill" is required in teaching the former. It should be noted, however, that the reliability of progress scores in reading was found to be much lower than the reliability of progress scores in arithmetic.

Betts (9) developed a questionnaire to discriminate between "novice" and "superior" teachers. He obtained a partial correlation coefficient of .4 between teachers' scores on this questionnaire and their pupils' gains on the Stanford Achievement Test, with the pupils' age and initial score on the achievement test partialed out.

In another study using partial correlation, Betts (8) argued that the students of a good instructor should have both a higher mean and a higher standard deviation of their scores on an achievement test. A higher mean would indicate that an instructor had not been neglecting his duller students; a higher standard deviation would indicate that everyone was progressing at his optimum rate. Betts used partial multiple correlation, a technique by which several variables are related to a criterion, with the effect of certain other variables partialed out. He related four measures of teachers' information and intelligence to their students' scores on a reading achievement test; the mean and standard deviation of the students' ages and the mean and standard deviation of their initial reading scores were partialed out. The resulting coefficient of partial multiple correlation between teacher measures and student reading achievement was .29, and between teacher measures and standard deviation of student reading achievement .42.

Betts also constructed a composite criterion, in which he combined student achievement and standard deviation of achievement.

Another method involving regression was utilized in a group of studies under the auspices of Barr (4, 5) at the University of Wisconsin. Since the first studies by Rostker (58), by Rolfe (57), and by LaDuke (40), and ones which followed by Lins (43) and by Jones (38), employed similar techniques, LaDuke's (40) procedure will be presented as an example of this technique.

In connection with a course concerned with the political and social organization of democratic society, LaDuke administered four pretests and post-tests of information and attitudes to thirty-four (three were later omitted) seventh and eighth grade classes. The mean change of each class in each of the four tests and in a composite of the four tests was determined. Then, by multiple regression the gain of each class in each of the tests and in the composite was predicted from the students' mental age, intelligence quotient, and pretest score. Finally, for each class, for each of the five measures of information and attitudes, the predicted mean gain was subtracted from the actual mean gain, and the teachers of the classes ranked on the basis of residual mean gain. The other above-mentioned studies at Wisconsin used this method of residual gain.

LaDuke (40) found that supervisory ratings of teachers were unrelated to the criterion of residual student gain, and that other measures of teachers were unrelated, generally, to this criterion. Intelligence of the teachers, however, was related to the criterion in some cases.

In Rostker's (58) study, supervisory ratings were not found to be related to a residual gain criterion. Of Rostker's various instructional measures, teachers' information, followed by their social attitude and knowledge of subject matter, was most closely related to residual student gain.

Rolfe (57) repeated Rostker's study. She found less relation between instructional measures and residual student gain than had Rostker.

Gotham (32) used Rolfe's residual gain data but found no association between residual student gain and teachers' scores on some personality tests.

Lins (43) attempted to predict the criterion of residual gain. He found that among the measures studied, the best predictor of pupil gain was the teacher's rank in his or her high school graduating class. Certain college grades of the teachers were related to pupil gain also. He found, however, that neither pupil ratings nor supervisor ratings were related to the gains criterion.

Von Haden (70) further studied Lins's teachers; he found that only 5 per cent of the coefficients of correlation between certain personal data of the teachers and the residual gain criterion were statistically significant.

Jones (38) examined the association between certain objective data and a residual student gain criterion. None of his coefficients of correlation was significant at the .01 level of confidence.

Riesch (56) did a study in this series. He related student gain in achievement and attitudes to certain instructional measures, but it is not clear whether or not Riesch used multiple regression in deriving his criterion. In any case, student gain was not found to be associated with measures of teachers' intelligence, achievement, and social adjustment.

Von Eschen (69) studied the effect of a special supervisory program and used Rolfe's (57) data for the control group. For the experimental group, he found that students' gain was related neither to the students' intelligence, to their reading ability, nor to their socio-economic status; he, therefore, used students' raw gain as a criterion of teaching efficiency for this group. The supervisory program seemed to be associated with students' gains on some of the tests but not on others. Von Eschen concluded that the supervisory program was most effective in those areas in which the program was most concentrated: silent reading and study skills.

Brandt (14) did a follow-up of four earlier investigations. After eight years for LaDuke and eleven years for Rostker, the correlations between some new ratings and the old pupil gain scores were higher but still not statistically significant.

Hellfritzsch (34) did a factor analysis on the data of Rostker (58) and on the data of Rolfe (57). In the analysis of Rostker's data, pupil gain was loaded on Factor 1: "General Knowledge and Mental Ability" (of teachers); in the analysis of Rolfe's data, on the other hand, pupil gain was loaded on its own factor only. Rostker's teachers taught in four-room schools, Rolfe's in one- and two-room schools. Hellfritzsch suggests that the weaker relation between instructional measures and pupil gain found by Rolfe may be a function of a student's being "on his own" more in a one-room school.

At Purdue University, Remmers et al. (55) studied instructors of a college course in chemistry. They predicted the mean chemistry grade for each section from the means of four student placement test scores. They then computed the difference between the predicted mean student grade and the obtained mean student grade for each instructor.

They also obtained student ratings of four laboratory traits and four recitation traits of the instructors. They found that student ratings of the four laboratory traits and of one recitation trait were associated with the difference between predicted and obtained student grade.

Anderson (1) investigated instructors of seven different high school courses (typing, mathematics, ninth grade English, eleventh grade English, general science, algebra, and world history). Anderson was unable to predict by multiple regression 25 per cent of the variance of student gains in achievement; therefore, he did not use the residual gain method. In four courses, however, high gains were associated with low pretest scores, so in these cases appropriate adjustments were made.

Mean scores for each class were converted to standard scores, and then adjusted, on the basis of published norms, for differences among the seven courses. That is, the scores for each course were multiplied by the ratio of the mean obtained score in the course to the mean of the norms for that course.

Anderson employed two other criteria. He predicted pretest achievement scores of students from their age, intelligence, and scholastic standing in achievement. The mean of the difference between actual and predicted pretest scores was found for each class and these mean differences converted to standard scores. The scores of the seven different course areas were made comparable in the above-described manner.

The final achievement test scores were treated as the pretest scores, except that in the case of the final score, the pretest score was used as a predictor of the final score.

Anderson's three criteria (student gain, student pretest score, and student post-test score) were related to ratings neither of students nor of supervisors.

Morsh et al. (51, 52) used a residual method in a study at the Air Force Personnel and Training Research Center. The adjustment of post-test scores of students in an hydrolics course was based on a multiple regression equation computed from within instructor and between classes variances and covariances (vide 51, pp. 17-18). The predictor variables were phase grade in Fundamentals, phase grade in Structures, phase grade in Electrical, and written pretest. The sum of the differences between predicted and actual post-test scores for the two classes taught by an instructor was taken as the instructor's effectiveness score.

The coefficient of reliability of effectiveness scores was estimated (by the Spearman-Brown formula) to be about .5. Instructor effectiveness was more closely related to student ratings than to supervisor or to peer ratings in this situation.

Sturgis (65) investigated by analysis of variance the influence of three teachers of physics at the Georgia Institute of Technology. Each of the instructors taught two groups of students. For one group, an instructor was given certain information about his students' personal background; for the other group, he was not given this information.

Student gain was analyzed by a regression method. The students were given pretests and post-tests of the Mechanics section of the Cooperative Physics Test. The students' gains in mechanics were adjusted for the regression of these gains on three student variables: grade point average, scholastic aptitude, and the mechanical pretest. An analysis of variance then was performed by instructor and by experimental condition on the adjusted student gains.

There were significant differences among instructors in the amount of adjusted gain of their students. Also, there were significant differences between the two methods: the students gained more if their instructors had the knowledge of personal background. The interreaction between instructor and method was significant.

Lord (44) proposed a regression formula for estimating the true gain between initial and final scores, and a formula for the reliability of these estimates. In his example with data obtained from 193 students, the coefficient of reliability was only .27. Lord's regression formula is based on the correlation between initial and final scores; it does not take into account other factors such as intelligence.

A study by Mitzel and Medley (49, 50) employed the method of covariance. A pretest and a post-test of reading was given to 826 pupils of forty-five teachers, who had recently begun instructing in grammar schools of New York City. An analysis of variance by teacher was done on the post-test reading scores of students. The technique of covariance eliminated, in the post-test scores, variation due to students' intelligence, and due to students' initial reading ability.

The coefficient of reliability (estimated by analysis of variance) for the adjusted instructor means was .87.

Mitzel and Medley found that the differences among schools in the adjusted final reading score were not statistically significant, but that the differences among grades (third, fourth, fifth, and sixth) were significant.

Silberman (61, 62) converted the means of these adjusted final reading scores to McCall T scores. He found that "praise" and "reproof" observed in the teaching behavior of the instructors were unrelated to the reading growth of their students.

Medley and Williams (47) further found that for these forty-five teachers, neither their scores on three scales derived from the Minnesota Multiphasic Personality Inventory nor scores obtained from their students' performance on a pupil reaction inventory were related to reading growth.

Mitzel and Gross (48) believe that the method of covariance utilizes more information than does the method of multiple regression used in the Wisconsin studies. They point out that in the multiple regression solution, adjustment in criterion means is based on between-class regressions; in the covariance solution, the adjustment is based on within-class regressions. The within-class regression, unlike the between-class regression, uses all the information in each individual score.

Medley and Mitzel (46) carried out an investigation using two measures of teaching influence. One measure was the adjusted reading growth discussed above; the other measure was growth in group problem-solving skill, as measured by the Russell Sage Social Relations Test.

The Russell Sage test requires that the class as a group devise and execute a plan for reconstructing a model shown them, using interlocking blocks. The teacher is absent during the test, and observers rate the class on its problem-solving.

The Russell Sage test was given at the beginning and at the end of the year. The final ratings were combined using weights obtained by the method of reciprocal averages; the initial ratings were then combined in the same manner. For each class, the final score was predicted from the initial, and the difference between the actual and the predicted score was taken as a measure of the teacher's efficiency in improving the class in group problem-solving.

Pupil ratings, supervisor ratings, and teacher self-ratings were also obtained.

In order to control differences among schools in the intercorrelations of these measures, variances and covariances were computed separately between and within schools. Only correlations estimated from covariation within schools were used in the study.

The growth in problem-solving was related neither to ratings nor to growth in reading. Growth in reading, however, was related significantly to teachers' self-ratings.

Reading growth was related to grade level (r = .5). The authors attribute this correlation to a maturational factor.

All of the studies discussed so far have dealt with the relation between instructors and the immediate performance of their students. Instructors, however, may be expected to have an influence not only on the immediate performance of their students but also on their subsequent performance.

In 1931, Lancelot (41) proposed four measures of teacher influence which he thought would be better than tests of acquisition:

1. Unannounced tests of retention. (Lancelot said this would be difficult to apply in college.)

2. The quality of work done by the students of a teacher when the students are enrolled later in related courses.

3. The per cent of a teacher's students who complete satisfactorily a sequence of related courses of which the teacher's course forms a part.

4. The per cent of students who return for later elective courses in the same subject-matter field.

Lancelot (42) studied a sequence of six mathematics courses taken by college engineering students. Six teachers of mathematics were compared in terms of the grades made by their students in later courses of the sequence and in terms of the per cent of their students taking subsequent courses of the sequence. By a procedure described by Lancelot, the probability of a teacher's students in a given course exceeding the average for the department in each of the two criteria was computed, and the probability of excelling in both criteria was computed. A double weight was given to the probability of excelling in both criteria.

Students were divided into "superior," "average," and "inferior" groups on the basis of their grades in college. The "inferior" group was eliminated later from the study, but separate analyses were done for the "superior" and "average" groups.

On the basis of "composite indices," Lancelot concluded that there was evidence for two types of teacher adaptation: adaptation to particular courses and adaptation to students of particular ability.

Beaumont (7), in a study of six instructors of elementary psychology, obtained some evidence for differences among the instructors in terms of the subsequent behavior of their students. He found differences among the teachers in:

1. Number of the teacher's elementary students taking advanced work in psychology.
2. Number of elementary students with grades of "A" and "B" taking advanced work in psychology.
3. Number of elementary students with grades of "C" and "D" taking advanced work in psychology.
4. Number of advanced courses taken by elementary students.
5. "A" and "B" grades received in advanced courses in psychology by elementary students.
6. "D" and "E" grades received in advanced courses in psychology by elementary students.

These analyses were computed on the basis of 100 students in each elementary section, in order to correct for number of students enrolled in the elementary courses of a teacher.

Webb and Bowers (71, 72) investigated the subsequent behavior of students of twelve naval flight instructors. The authors performed an analysis of variance by instructor on subsequent flying grades of students, and found significant differences among instructors. They found no significant differences among instructors in their students' Flight Aptitude Rating.

Jacob (36) reports the results of a survey designed to determine what changes do occur in a student's pattern of values during college, and to what extent such changes stem from exposure to various types of social science instruction in the "general" part of the curriculum. Jacob concludes that although for most students the quality of teaching has little effect on the value-outcomes of general education, there are individual exceptions. "Student testimony and perceptive observation by educators and counsellors indicate, however, that some teachers do exert a profound influence on some students, even to the point of causing particular individuals to re-orient their philosophy of life and adopt new and usually more socially responsible vocational goals" (36, pp. 7-8).

To summarize: a number of studies dealing with the influence of instructors was examined. In general, the results of these studies indicate that instructors do have an influence on both the immediate and the subsequent performance of their students.

In regard to immediate influence, a few of the investigations were concerned directly with the question: can instructors be differentiated on the basis of their students' performance? This question, for example, was asked in the studies by Sturgis (65) and by Mitzel and Medley (49, 50); in both instances, statistically significant differences among instructors were obtained.

Perhaps the most direct test of whether or not instructors have a more lasting influence on students was made by Webb and Bowers (71, 72). These investigators found reliable differences among instructors on the basis of the future behavior of the instructors' students.

Most of the research in this field seems to have been concerned with immediate rather than with subsequent performance of students. The present study, then, will investigate further the relation between teachers and the future behavior of their students.

One of the biggest problems in research of this type is the control of extraneous factors that may influence student performance. In the present investigation, two aspects of student performance will be studied: choice behavior and grades. Irrelevant factors associated with grades will be controlled by the technique of covariance. Because of the dichotomization involved in choices, irrelevant factors associated with them are less easily controlled; some of these extraneous factors will be examined here, but no attempt will be made to control them.

It is to be noted that of the above-reviewed studies, only the one by Beaumont (7) appeared to be concerned much with the choice behavior of students. Beaumont studied the relation between teachers of elementary psychology and the advanced work done in psychology by their students.

The results of Jacob's (36) survey indicate that the general influence of teachers may be slight, that perhaps, at most, only some teachers influence some students. Jacob was examining the value-outcomes of instruction in social science so it is unlikely that his conclusions can be generalized directly to the present study. However, the general influence of instructors may be slight here also; it is only to be hoped that, with the large number of students sampled, the instructor's influence, however slight or particular, can be detected.

Present study

The subjects of this investigation will be students enrolled in "C-2--the Physical Sciences" (a basic comprehensive course of the University College at the University of Florida) and their instructors, for the year 1958-1959.

The first semester of C-2 (C-21) is a general course in physical science. For the second semester (C-22), a student chooses one of several specialties for further study. The three possible variants in 1958-1959 were astronomy, geology, and physics.

The relation between instructor and student progress will be investigated in two ways:

1. The relation between C-21 instructors and their students' choice of variant in C-22.

2. The relation between C-21 instructors and the grades obtained by their students in C-22.

In regard to the question of selection of variant in the second semester, one hypothesis, stated as a null hypothesis, is:

(1) There is no difference in student choice of second semester variant on the basis of student's first semester instructor.

Other factors may be expected to be related to the choice of second semester variant. One of these factors is the sex of the student. Thus, another hypothesis to be tested is:

(2) There is no difference in student choice of second semester variant on the basis of student's sex.

Hypotheses (1) and (2) will be tested by factorial chi square.

Another factor which may be related to a student's choice of second semester variant is his scores on C-21 progress tests. The first progress test is heavily weighted in astronomy, the second in geology, and the third in physics. Thus, a student who received a relatively high grade on one of the tests may choose the variant whose subject matter was weighted on the test. Or, a student who received a low grade on a progress test may avoid the corresponding variant. In general, it may be expected that for students enrolled in the three variants of C-22 there would be differences in the patterns of their grades on the three progress tests. Students enrolled in geology, for example, might have done best on the progress test weighted in geology. The hypothesis to be tested is:

(3) There are no differences among the patterns of progress test grades in C-21 for students choosing different variants in C-22.

Hypothesis (3) will be tested by analysis of variance. The analysis will be done on progress test grades by progress test and by chosen variant. A student's choice of variant may be related also to previous interests and abilities. One measure of such interests and abilities is his scores on the High School Placement battery, which has the following five subtests: Psychological Examination (intelligence), English, Social Studies, Natural Science, and Mathematics. Students enrolled in geology, for example, may do relatively well on the English test while students enrolled in physics may do relatively well on the Mathematics test. Another hypothesis, then, is:

(4) There are no differences among the patterns of High School Placement subtest scores for students choosing different variants in C-22.

Hypothesis (4) will be tested by analysis of variance. The analysis will be done on subtest scores by subtest and by chosen variant.

Further, a student's choice of variant may be related to his scores on the A. C. E. intelligence test, which has two subtests: Quantitative and Linguistic. A fifth hypothesis, then, is:

(5) There are no differences among the patterns of A. C. E. subtest scores for students choosing different variants in C-22.

Hypothesis (5) will be tested by analysis of variance on subtest scoresby subtest and by chosen variant.

In investigating the relation between first semester instructor and the second semester grade received by their students, some attempt will be made to control extraneous variables. The second semester grade may be thought to be contingent not only on first semester instructor but also on such factors as student intelligence, student abilities and interests, size of C-21 section, and size of C-22 section.

Some factors, then, which may be associated with second semester grade are:

1. High School Placement test scores (Psychological Examination, English, Social Studies, Natural Science, Mathematics, and Total)

2. A. C. E. scores (Quantitative and Linguistic)

3. Size of C-21 section

4. Size of C-22 section

In order to control these factors, which may vary with C-22 grade, the method used to test the relation between first semester instructor and second semester grade will be analysis of covariance.

First, the correlation coefficients between C-22 grade and the various predictor variables will be determined.

Then, an analysis of variance by first semester instructor will be done on C-22 grade. By the method of covariance, the means of arrays (instructors) are made comparable with respect to variable or variables highly related to C-22 grade.

The hypothesis to be tested here is:

(6) There is no difference in second semester student grade on the basis of first semester instructor. This hypothesis will be tested by analysis of covariance.

The final C-22 grades of astronomy, geology, and physics students will be considered together. That the grades are centiles assures that the means of the three groups will be comparable, but it is still possible that students of the three variants differ in ability. The adjustment of instructor means by the method of covariance will reduce some of the differences in C-22 grades due to differences in student ability but will not eliminate systematic differences among variants. It is felt, however, that to do separate analyses for each variant would seriously reduce the number of students on which the instructor means are based. What will be determined, then, is how students of a given instructor perform in their chosen variants, with student ability controlled without regard for which variant contributes a given student's C-22 score.

The rejection of null hypotheses (1) or (6) would be evidence that the behavior of students after C-21 is contingent, at least in part, on which instructor the student had in C-21.

Background data for instructors will be gathered (see Appendix A). The present results will be considered in the light of these background data.

CHAPTER 2

PROCEDURE

Students

The subjects for this study included 915 students who were enrolled in C-21 in the Fall of 1958 and in C-22 in the Spring of 1959.

In addition to the 915 studied, however, there were 584 other students who took C-21 in the Fall of 1958 but did not take C-22 in the Spring of 1959, and 168 students who took C-22 in the Spring but had not taken C-21 in the Fall. The final C-21 centile grades of those who were enrolled in C-21 but not in C-22 are given in Table 1; the final C-22 centile grades of those who were enrolled in C-22 but not in C-21 are given in Table 2.

A final centile score of 09 or better is a passing grade in C-21. In C-22, a centile score of 14 or better is passing in geology, of 06 or better in physics, and of 10 or better in astronomy.

Instructors

For 1958-1959, there were twenty instructors teaching fifty-seven sections of C-21 in the Fall and eighteen instructors teaching forty-four sections of C-22 in the spring. Sixteen instructors teaching one or more sections of C-21 in the Fall also taught one or more sections of C-22 in the Spring, and of these sixteen, nine taught geology in

Table 1

Final C-21 Centile Grades of 584 Students Who Were Enrolled In C-21 In The Fall of 1958 But Not In C-22 In The Spring of 1959

Centile Grade	Number of Students
90-99	28
80-89	29
70-79	40
60-69	40
50-59	36
40-49	45
30-39	39
20-29	60
10-19	40
00-09	98
No grade	129
Total	584

Table 2

Final C-22 Centile Grades of 168 Students Who Were Enrolled in C-22 in the Spring of 1959 but Not in C-21 in the Fall of 1958

Centile Grade	Number of Students
90-99	19
80-89	10
70-79	14
60-69	20
50-59	14
40-49	24
30-39	19
20-29	14
10-19	14
00-09	13
No grade	7
Total	168

C-22, three taught physics, two taught astronomy, and two taught both physics and astronomy. All instructors were males.

Questionnaires were given to the twenty instructors (see Appendix A), and seventeen of the questionnaires were completed and returned.

The range of ages for the seventeen instructors was twenty-nine to sixty-seven years; the median age was forty-six.

Fifteen instructors were married, two were single. Two had three children, seven had two, four had one, and four had none.

Table 3 shows the highest degree obtained. It can be seen that nine instructors had Master's degrees and eight had Doctor's degrees.

Table 3

Highest Degree Reported for Seventeen Instructors

Highest Degree	Number of Instructors
Ph. D.	6
Ed. D.	2
M. A.	2
M. S.	6
M. Ed.	1
Total	17

Table 4 indicates in which field of specialization the highest degree was obtained. Table 5 indicates in which field of specialization degrees other than the highest were obtained. Nine of the instructors stated that they had received degrees in more than one specialization.

Table 4

Field of Specialization of Highest Degree Obtained for Seventeen Instructors

Field of Specialization	Frequency
American History	1
Economic Geology	1
Educational Administration	1
Geography	3
Geography and Education	1
Geology	1
Mathematics	3
Physical Chemistry	1
Physics	4
Sedimentation	1
Total	17

Table 5

Field of Specialization of Degrees Other Than Highest Obtained for Sixteen Instructors

Field of Specialization	Frequency
Chemistry	2
Educational Administration	1
Forest Products	2
General Science	1
Geography	3
Geology	4
Mathematics	4
Organic Chemistry	1
Physical Science	2
Physics	2
Science and Education	1
Total	23

The range of years of teaching was one to forty, the median twelve. Ten instructors reported additional professional experience.

In reply to Item 9: Which variant would you prefer that C-22 students take? fifteen instructors marked "depends on student," one marked "Geology," and one wrote in "Take what they want to take."

In reply to Item 10: How important do you think the subject matter you teach in C-21 is in terms of what students ought to learn in a physical science course? sixteen instructors marked "Important" and one marked "About as important as could be expected."

The distribution of responses to Items 11, 12 and 13 is shown in Table 6. It is noted that no instructor reported being professionally uninterested in any of the variants.

Table 6

Distribution of Responses to the Questions: To What Extent Are You Interested Professionally in Astronomy? in Geology? in Physics?

Response	Frequency of Response Astronomy	Geology	Physics
Very Interested	4	5	6
Moderately Interested	8	6	6
Mildly Interested	3	6	2
Neutral	1	0	2
Mildly Uninterested	0	0	0
Moderately Uninterested	0	0	0
Very Uninterested	0	0	0
No Reply	1	0	1
Total	17	17	17

C-2--The Physical Sciences

C-2 is one of the six basic comprehensive courses of the University College. It is described as follows:

> The primary aim of the course is to give the student a working knowledge, through the solution of numerous problems, of the physical factors in the environment which affect the development of civilization, with its various cultures. These factors are primarily space relations, weather and climate, landforms, and material and energy resources. The concepts are taken from the fields of astronomy, physical geography, meteorology and climatology, geology, chemistry, and physics (68, p. 299).

The textbook used in C-21 was Our physical environment by Gaddum and Knowles (29).

In C-22, the books for astronomy and geology were respectively A brief text in astronomy by Skilling and Richardson (63) and The physiographic provinces of North America by Atwood (2). The books for physics were Semat's Physics in the modern world (59) and Galilei's Dialogues concerning two new sciences (30). In addition to the textbooks for C-22 mentioned above, departmental syllabi were used in each variant.

In C-21 each week a student is scheduled to attend one hour of lecture and three hours of discussion. The lectures, given to large numbers of students, are rotated among different members of the teaching staff. The discussion sections are smaller, and for a given student the instructor remains constant during the semester; in this investigation, it is the discussion instructor who will be considered the student's C-21 instructor.

There is in C-21 an honors program, which allows a student in the program not to attend classes. To remain in the program, however, it is necessary that a student receive an A on every progress test, but in the Fall of 1958 none of these students (about fifteen) was able to meet the requirement, most dropping out the program after the first test.

In registering for C-21, only an occasional student would be able to get an instructor of his choice since the names of the instructors are not published. After school starts, there is some switching of students from one section to another, but most of the switching is on an individual student basis.

Student measures

A student's final C-21 centile grade is obtained from points he has accumulated on three progress tests and on the final examination. The tests and examination are departmental; that is, they are the same for all students in the course.

Although on a progress test it is only the raw score which enters into the determination of a final grade, a centile score and a letter score also are reported to each student. Progress test data were most available in terms of centile scores so these were used in this investigation. It should be noted, however, that the relation between centile scores and letter grades varied slightly among the three C-21 progress tests.

The final C-22 centile grade is based on points received by a student on two tests and on a final examination.

All C-21 and C-22 tests and examinations were of the objective type.

The sizes of a student's C-21 and C-22 sections were taken to be the total number of students enrolled in the section at the close of the relevant semester.

There are five High School Placement tests:

1. A. C. E. Psychological Examination, High School Edition
2. Cooperative English (Effectiveness of Expression)
3. Cooperative General Achievement in Social Studies
4. Cooperative General Achievement in Natural Sciences
5. Cooperative General Achievement in Mathematics

The centile scores of the five subtests are added to give a sixth score. If this sum of five centiles is less than 200, then the student usually is not admitted to the University.

The Placement tests are given routinely to all twelfth grade students in Florida. Other students, before they are admitted to the University of Florida, are required to take the tests although there are some exceptions; the exceptions are mostly University employee, transfer, or foreign students.

The A. C. E., 1949 College Edition, is given to most entering students, and centile scores are available for the Quantitative, the Linguistic, and the Total tests.

Missing data

The College of Nursing at the University of Florida requires that all their students take the physics variant in C-22. It is recommended that prospective nursing students take physics in the first semester of their second year.

A list of prospective and enrolled nursing students was obtained from the College of Nursing. Seventeen such nurses were found to have taken C-22 in the Spring of 1959, and these students were omitted from the analyses involving choice in the present study. It was later discovered, however, that one of the seventeen nurses, a student who subsequently dropped out the nursing program, had taken geology rather than physics.

In any case, the list of prospective nurses is probably incomplete, and there might have been in C-22 other women who took physics with a more or less clear plan of taking nursing later.

Three students, having dropped C-21, had C-22 grades but these students were omitted because they could not be assigned to a C-21 instructor.

Thirty-nine other students lacked either C-21 progress test scores or High School Placement scores or A. C. E. scores. These students were omitted from certain analyses; the omissions will be indicated below when they occur.

In addition, twenty-one students had no final C-22 grade and were left out of analyses involving C-22 grade.

Factorial chi square

Factorial chi square was used to test the relations among student's sex, student's C-21 instructor, and student's choice of variant. This statistic was devised by A. E. Brandt (13) and allows for the partitioning of chi square in contingency tables of various dimensions. Thus, in this study, the interaction of the effects of sex and instructor on choice of variant could be investigated, although, as mentioned below, the method was handicapped by disproportionate frequencies.

CHAPTER 3

RESULTS

Choice of variant

Table 7 presents the distribution of choice of variant in C-22 for 895 students enrolled in C-21 in the Fall of 1958 and in C-22 in the Spring of 1959; three students who dropped C-21 and seventeen nurses were omitted. The choices of male and of female students are presented separately.

In Table 8 it can be seen that the students' choice of geology or non-geology is related significantly to the students' sex ($p < .001$), but not to the students' C-21 instructor. ($.10 > p > .05$) The direction of the relation between students' sex and choice of variant is such that relatively more males chose non-geology.

It is seen also that the interaction of sex and instructor on student choice was not statistically significant, but it should be noted that probably the size of the interaction was underestimated somewhat by disproportionate frequencies.

In this analysis, because of extremely small expected frequencies that otherwise would have occurred in some of the cells, the choices of astronomy and physics were considered together as "non-geology."

In spite of considering astronomy and physics together, some of the expected frequencies were still small. Therefore, another analysis

Table 7

Distribution by C-21 Instructor of 895 Students' Choices of Three Courses in C-22

Instructor	Male Students				Female Students			
	Geology	Physics	Astronomy	Total	Geology	Physics	Astronomy	Total
1	6	4	2	12	2	2	0	4
2	14	5	5	24	15	4	2	21
3	37	20	9	66	25	5	4	34
4	4	1	2	7	12	2	2	16
5	10	5	2	17	8	1	1	10
6	15	6	4	25	21	2	7	30
7	7	10	2	19	11	1	1	13
8	12	8	4	24	11	5	2	18
9	19	12	2	33	24	3	2	29
10	21	12	3	36	14	2	1	17
11	4	0	0	4	12	4	8	24
12	15	5	3	23	28	2	1	31
13	12	6	6	24	9	1	0	10
14	11	10	9	30	17	3	1	21
15	16	5	2	23	31	2	1	34
16	13	4	7	24	10	1	3	14
17	14	15	3	32	13	3	2	18
18	21	5	6	32	22	4	1	27
19	14	6	2	22	9	0	2	11

Table 7 (continued)

Instructor	Geology	Physics	Astronomy	Total	Geology	Physics	Astronomy	Total
20	10	4	3	17	16	2	1	19
Total	275	143	76	494	310	49	42	401
Per cent	55.7	28.9	15.4	100.0	77.3	12.2	10.5	100.0

Table 8

Relation between Twenty C-21 Instructors and 895 Students' Choice of Geology or Non-Geology in C-22

Source	D. F.	Sum of squares	Factor	Chi square	Level
Instructor	19	6.2339	4.417	27.535	$.10 > p > .05$
Sex	1	10.3636	4.417	45.776	$p < .001$
Interaction	19	2.8895	4.417	12.763	$.90 > p > .80$
Total	39	19.4870			

was done, in which only those instructors who had both twenty or more male and twenty or more female students were included. The results of this analysis are presented in Table 9.

It can be seen that for the eight instructors who had twenty or more students of each sex, the students' choice of geology or non-geology is related significantly both to the students' sex ($p < .001$) and to the students' C-21 instructor ($p < .05$). The interaction of sex and instructor was not significant; the negligible, and in this case negative, interaction sum of squares is a result of disproportionate frequencies.

Table 9

Relation between Eight C-21 Instructors and 483 Students' Choice of Geology or Non-Geology in C-22

Source	D. F.	Sum of squares	Factor	Chi square	Level
Instructor	7	3.3873	4.637	15.707	$.05 > p > .02$
Sex	1	6.2567	4.637	29.012	$p < .001$
Interaction	7	-0.0007	4.637		
Total	15	9.6433			

In view of the relatively strong association between the sex of a student and the student's choice of variant (phi = .23), it was felt that perhaps the obtained difference in choice on the basis of instructor might have resulted from some instructors having more male students and other instructors having more female students. Thus, two further chi squares were computed; one for male students, and one for female students.

For fourteen instructors who had twenty or more male students, the choices of 418 male students were found not to be contingent on what instructor the students had in C-21 (chi square = 11.795, $.7 > p > .5$). For nine instructors who had twenty or more female students, however, the choices of 251 female students were found to be contingent on C-21 instructor (chi square = 19.658, $p. < .02$).

To return to Table 7, the bottom row gives for all the male students and for all the female students the per cent of students enrolled in each of the three variants in C-22. A comparison of the behavior of a particular instructor's students to the behavior of all the students furnishes in certain cases additional tentative evidence for instructors' influence in the choice of variant, when the comparison takes into account other information about the instructor (see Appendix A):

A disproportionately large number of the female students of instructors six and eleven took astronomy. Instructor six taught astronomy in C-22, and indicated on the questionnaire that he was very interested professionally in astronomy but only moderately interested in geology and physics. Instructor eleven, who also taught astronomy in C-22, indicated that he was very interested professionally in astronomy and physics, but only mildly interested in geology.

Instructor twelve, a geologist, contributed more female students to the geology variant than would be expected. Instructor one, a physicist, likewise, contributed a relatively large number of students to physics.

Some of the apparent influence, however, is not in the predicted direction:

Instructors seven, fourteen, and seventeen, who taught geology in C-22, furnished a large number of male students to physics; instructor fourteen also contributed nine students to astronomy. In any case, instructor seven, although he indicated more professional interest in geology than in physics or astronomy, reported experience teaching physics in high school.

Instructor fifteen taught physics in C-22, but contributed a relatively large number of students of each sex to geology.

Instructor eighteen, who taught physics in C-22 and who stated he was most interested professionally in physics contributed more than his share of women to physics but less than his share of men.

Other possible examples of instructional influence may be found in Table 7. It should be with caution only, however, that conclusions are drawn in this manner: that is, with small numbers of cases and without prior hypotheses.

Table 10 shows the means and standard deviations of centile scores of the three C-21 progress tests for 856 students enrolled in both semesters of C-2 in the year 1958-1959. The seventeen nurses and the three students who dropped C-21 were omitted from this analysis; thirty-nine other students who lacked either C-21 progress test scores or High School Placement scores or A. C. E. scores were omitted also.

An analysis of variance on C-21 progress test centile scores by progress test and by choice of variant is presented in Table 11. It can be seen that the effect of variant was significant ($p < .001$), but that the effect of progress test was not ($p > .05$). The interaction of variant and progress test was significant ($p < .05$). This interaction can be seen also in Table 10 by an examination of the means; astronomy

Table 10

Means and Standard Deviations of Centile Scores on Three C-21 Progress Tests for 856 Students Enrolled in the Three Variants of C-22

Variant	Number	Test 1		Test 2		Test 3	
		Mean	S. D.	Mean	S.D.	Mean	S. D.
Astronomy	113	66.19	27.5	61.98	27.9	57.61	25.9
Geology	561	52.59	26.5	54.19	26.6	51.96	27.8
Physics	182	63.52	26.6	58.27	28.4	64.95	25.1
Total	856	56.71	27.2	56.09	27.3	55.46	27.5

means were especially high on Test 1 and physics means especially high on Test 3.

The assumption of homogeneity of variance appeared to be satisfied fairly well ($F = 1.28$; d. f. = 181, 181; $.10 > p > .02$).

Table 11

Analysis of Variance on Centile Scores of Three C-21 Progress Tests by C-21 Progress Test and by Choice of Variant for 856 Students Enrolled in C-22

Source	D. F.	Mean Square	F	Level
Variant	2	24615.28	33.95	$p < .001$
Progress Test	2	332.51	<1.00	$p > .05$
Interaction	4	2373.28	3.27	$p < .05$
Within	2559	725.06		
Total	2567			

Table 12 shows the means and standard deviations of centile scores on five High School Placement tests (Psychological Examination, English, Social Studies, Natural Science, and Mathematics).

Table 12

Means and Standard Deviations of Centile Scores on Five High School Placement Tests for 856 Students Enrolled in the Three Variants of C-22

Variant	Number	P.E.		English		S.S.		N.S.		Math.	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Astronomy	113	78.45	17.5	76.35	19.0	78.13	18.8	76.74	17.9	80.96	14.6
Geology	561	72.76	18.7	73.34	19.3	73.08	19.7	68.50	18.6	67.32	18.8
Physics	182	74.38	19.7	73.20	21.4	75.30	21.4	77.09	17.9	83.15	13.5
Total	856	73.86	18.9	73.71	19.7	74.22	20.0	71.42	18.8	72.48	18.7

An analysis of variance on placement scores by placement test and by variant is seen in Table 13. Significance was found for the effect of variant ($p < .001$), for the effect of placement test ($p < .05$), and for interaction of variant and placement test ($p < .001$). Table 12 shows that the means on the Mathematics test were especially high for the to-be-astronomy and to-be-physics students.

It should be noted that in this analysis the assumption of homogeneity of variance was not met ($F = 2.51$; d.f. = 181, 181; $p < .002$).

The means and standard deviations of the centile scores for the Q and L tests of the A. C. E. are presented in Table 14.

Table 13

Analysis of Variance on Centile Scores of Five High School Placement Tests by Placement Test and by Choice of Variant for 856 Students Enrolled in C-22

Source	D. F.	Mean Square	F	Level
Variant	2	18976.87	53.38	$p < .001$
Placement Test	4	1155.52	3.25	$p < .05$
Interaction	8	3295.20	9.27	$p < .001$
Within	4265	355.53		
Total	4279			

Table 14

Means and Standard Deviations of Centile Scores on Two A. C. E. Tests for 856 Students Enrolled in the Three Variants of C-22

Variant	Number	Q		L	
		Mean	S.D.	Mean	S.D.
Astronomy	113	64.04	21.7	53.04	25.3
Geology	561	50.80	24.0	52.51	25.7
Physics	182	64.29	21.5	53.79	26.7
Total	856	55.41	24.0	52.85	25.8

The analysis of variance on A. C. E. scores by A. C. E. test and by variant is presented in Table 15. Differences due to both effects and to interaction of effects are reliable. Table 14 shows high Q scores for the astronomy and physics groups.

In this analysis again, the hypothesis of homogeneous variances was rejected ($F = 1.55$; d. f. = 181, 181; $p < .02$).

Table 15

Analysis of Variance on Centile Scores of Two A. C. E. Tests by A. C. E. Test and by Choice of Variant for 856 Students Enrolled in C-22

Source	D. F.	Mean Square	F	Level
Variant	2	10023.09	16.62	$p < .001$
A. C. E. Test	1	2804.02	4.65	$p < .05$
Interaction	2	7445.89	12.35	$p < .001$
Within	1706	603.00		
Total	1711			

Table 16 gives the point biserial coefficients of correlation between ten scores and the choice of geology (v. non-geology) in C-22 for 856 C-22 students. It can be seen that although students choosing non-geology received higher scores on all ten tests, the relation between test score and choice is highest for two tests concerned with mathematics: the Mathematics subtest of the high school battery and the Quantitative subtest of the A. C. E.

Table 16

Point Biserial Coefficients of Correlation Between Ten Scores and the Choice of Geology (v. Non-Geology) for 856 C-22 Students

Test	rpb*
C-21 progress test	
1	-.21
2	-.10
3	-.18
High School Placement test	
Psychological Examination	-.08
English	-.03
Social Studies	-.08
Natural Science	-.21
Mathematics	-.38
A. C. E. test	
Quantitative	-.27
Linguistic	-.02

*rpb of .07 is significant at the .05 level; rpb of .09 is significant at the .01 level.

C-22 grade

Table 17 shows the means and standard deviations of twelve variables for 852 C-22 students. Students omitted from this part of the study, the part that deals with C-22 grades, included the three students who dropped C-21 and sixty students who lacked either C-21 progress test scores or High School Placement scores or A. C. E. scores or final C-22 score; nurses were not omitted specifically.

The product moment correlation maxtrix for these twelve variables is presented in Table 18.

It was decided that, for the analysis of covariance, the sixth variable, the sum of five High School Placement centiles, would be selected as the covariant of C-22 grade. Although this score correlates with C-22 grade slightly less than does High School Mathematics (.22 v. .24), it is administratively more widely used in the selection of University of Florida students. The High School Total score also has a further advantage: the summing operation tends to normalize the centile scores, which have, at least orginally, rectangular distributions.

Table 19 gives the product moment correlation coefficients of High School Total score with C-22 grade, computed separately for astronomy, geology, and physics. It is seen that the astronomy and physics grades are predicted better than the geology grade. Nevertheless, for the reason mentioned above, the analysis of covariance will be done without regard for which variant contributes a given student's score.

Table 17

Means and Standard Deviations of Scores on Twelve Variables for 852 C-22 Students

Variable	Mean	S. D.
High School Placement test		
Psychological Examination	73.72	19.01
English	73.88	19.81
Social Studies	74.12	19.95
Natural Science	71.46	18.93
Mathematics	72.51	18.66
Total	366.19	73.98
A.C.E.		
Quantitative	55.43	23.85
Linguistic	52.89	25.88
Size of C-21 section	26.97	3.65
Size of C-22 section	26.04	5.39
Final C-21 centile score	55.05	27.21
Final C-22 centile score	50.89	29.19

Table 18

Product Moment Correlation Matrix for Twelve Variables for 852 C-22 Students*

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. High School P. E.												
2. High School Eng.	55											
3. High School S. S.	62	45										
4. High School N. S.	52	33	55									
5. High School Math.	48	30	43	51								
6. High School Total	80	67	79	73	69							
7. A. C. E. Q	48	27	30	26	55	48						
8. A. C. E. L	73	54	56	47	35	68	41					
9. C-21 section size	-02	-07	-02	-00	01	-06	01	01				
10. C-22 section size	-11	-08	-12	-13	-10	-08	-03	-06	-02			
11. C-21 grade	27	16	26	30	44	36	37	25	09	-02		
12. C-22 grade	17	09	16	20	24	22	16	17	07	01	60	

*Decimal points omitted. r of .07 is significant at the .05 level; r of .09 is significant at the .01 level.

Table 19

Product Moment Correlation Coefficients of High School Total Score with Astronomy, Geology, and Physics Final Centile Scores

Variant	N	r
Astronomy	109	.34
Geology	548	.16
Physics	195	.32

C-21 grade, seen in Table 18 to be correlated highly with C-22 grade, could not be used as a covariant, because it might have been influenced by C-21 instructor.

Table 20 shows the final C-22 centile grades of 852 students of twenty C-21 instructors.

The preliminary analysis of variance by C-21 instructor on student final C-22 grades is presented in Table 21. It can be seen that the effect of instructor was not significant.

Next, adjustments were made with High School Placement Total score as a covariant, but after the covariance adjustments, the differences among C-21 instructors in student C-22 grade still were not reliable. ($F = < 1.00$). Since the instructor effect was not reliable, the adjusted instructor means were not computed.

Size of section

It is seen in Table 18 that the size of C-21 section is related both to C-21 and to C-22 grade; these correlations, .09 and .07,

Table 20

Mean C-22 Centile Grades of 852 Students of Twenty C-21 Instructors

Instructor	Number of students	Mean student C-22 centile grade
1	17	58.65
2	42	47.26
3	95	54.38
4	21	48.10
5	29	50.07
6	50	51.70
7	29	56.17
8	41	48.78
9	59	50.00
10	50	51.90
11	28	44.71
12	55	52.45
13	32	55.75
14	46	48.20
15	53	50.30
16	37	48.08
17	45	49.71
18	61	51.16
19	31	50.26
20	31	48.90
Total	852	50.89

Table 21

Preliminary Analysis of Variance by C-21 Instructor on Final C-22 Centile Grades of 852 Students

Source	D. F.	Mean square	F	Level
Instructor	19	360.0849	<1.00	$p > .05$
Within	832	865.0564		
Total	851			

respectively, are small but significant, with students in the larger sections receiving higher grades. The size of C-22 sections, on the other hand, is not related to C-22 grade.

There are small but significant negative correlations between C-22 section size and each of the six High School Placement scores. The mean C-22 section size for astronomy was 16.2, for geology 26.8, and for physics 29.2. Since, as seen in Table 12, astronomy students tended to score relatively high on the Placement tests, it would seem that the negative correlation between C-22 section size and Placement scores resulted from the small C-22 sections and the high Placement scores of astronomy students. That this is not the case, however, is indicated by statistically significant negative correlations between C-22 section size and four High School tests, when the correlations are computed for astronomy students only; these four High School tests are Psychological Examination, Social Studies, Natural Science, and Total.

When correlations are computed separately for geology students, there is a negative association of C-22 section size with High School Social Studies and with High School Total; but, when correlations are computed separately for physics students, there is no association of C-22 section size with High School scores.

In addition, for astronomy students and for geology students, size of C-22 section was correlated negatively with A. C. E. Linguistic score.

One possible explanation for the obtained negative relations between section size and measures of ability is that better students may be more willing to register for sections that meet at unpopular times. In order to enroll in astronomy rather than in another variant, for example, more brighter students than duller ones might have been willing to register for a section of astronomy that met at an unpopular hour. In any case, the tendency for students with high Placement and A. C. E. scores to be in small C-22 sections appears to be associated more with general ability of students than with mathematical ability.

CHAPTER 4

DISCUSSION

In regard to selection of variant, evidence was obtained for the rejection of null hypotheses (2), (3), (4), and (5):

(2) There is no difference in student choice of second semester variant on the basis of student's sex.

(3) There are no differences among the patterns of progress test grades in C-21 for students choosing different variants in C-22.

(4) There are no differences among the patterns of High School Placement subtest scores for students choosing different variants in C-22.

(5) There are no differences among the patterns of A. C. E. subtest scores for students choosing different variants in C-22.

When data for instructors with small numbers of students were omitted, evidence also was obtained for rejection of null hypothesis (1):

(1) There is no difference in student choice of second semester variant on the basis of student's first semester instructor.

A student's selection of variant, then, was found to be related to the student's sex, scores on C-21 progress tests, scores on High School Placement tests, and scores on the A. C. E. test.

With the aid of background data obtained for seventeen instructors, some additional evidence for individual instructors' influence was found, but interpretations of this type are, at best, tentative.

The sixth null hypothesis was accepted:

(6) There is no difference in second semester student grade on the basis of first semester instructor.

There was no evidence that C-21 instructors influenced their students' C-22 grades. It seems, thus, that if the instructors influenced the subsequent behavior of their students, they did it mainly by influencing the choice of C-22 variant.

No attempt was made to determine how an instructor influenced his students. The influence could vary from the arousing of an interest in the subject matter of a particular variant to the more or less direct recruiting of students for the instructor's own second semester sections. A female student of a physicist, for instance, might have done well on the C-21 progress test concerned with physics and might have been encouraged later by her instructor to register for physics in C-22. Also, the influence could be in the other direction; an instructor could reduce interest in a variant.

In relation to other factors such as mathematical ability, the influence of instructor on students' choice of variant was found to be slight in this study. It was noted above that students were exposed during the course of the semester not only to their discussion instructors but also, once a week, to lecture instructors; the lecture instructors might have influenced students also. In other situations, where there is only one instructor involved, it is possible that the influence of the regular instructor would be greater.

The factors measured in this study did not account for all the choice behavior of the students. Other factors might have entered into the choice of an individual student. A student might have chosen a course because it met at a convenient time. Or, a student might have chosen a course because one of his friends chose it. A female student might have chosen physics because she was considering vaguely the possibility of entering the College of Nursing at some later time. Some students, after reading newspapers or magazines, might have thought it was "the thing to do" to study physics or astronomy. Further investigations could take into account such factors.

In regard to the analyses of variance presented in Tables 13 and 15, it was noted that the assumption of homogeneity of variance was not met. Since, in both analyses the interaction effect was significant at the .001 level of confidence, the failure to meet the assumption of homogeneity of variance should not affect the conclusions drawn from these two analyses.

Subjects for this study were about 900 students, who took C-21 and C-22 in the year 1958-1959. The C-2 course varies from year to year; in some semesters, for example, variant "X," a general course in physical science, is offered in C-22. The instructors change also. In any case, the conclusions of the present investigation cannot be generalized directly to other years, but hypotheses suggested by them can be tested. Thus, an understanding of the factors operating in C-2 can be acquired gradually through the accumulation of evidence and the testing of hypotheses.

It is even more difficult to generalize to physical science programs in other colleges. Evidence concerning the factors operating at the University of Florida, nevertheless, can be compared with evidence obtained elsewhere. On the basis of the present study, students' sex and mathematical ability would be expected to be factors important in accomplishment and in choice of course in the physical sciences, and these factors could be looked for in such departments in other colleges.

As situations change, results can be expected to change also. No evidence was found in the present investigation, for example, for the influence of instructors on the subsequent grades of their students, while in the investigation by Webb and Bowers (71, 72), in a military situation involving the teaching of flying, such evidence was found.

The greatest value of this study, then, would be to give a wider perspective of the Physical Sciences course at the University of Florida and to furnish hypotheses about this course. Other value would be to present evidence for comparisons with less similar situations.

CHAPTER 5

SUMMARY AND CONCLUSION

Summary

The purpose of the present study was to investigate the relation between instructors and the subsequent performance of their students.

Subjects were about 900 University of Florida students enrolled in "C-2--the Physical Sciences" and their instructors for the year 1958-1959. The first semester of C-2 (C-21) is a general course in physical science. For the second semester (C-22), a student chooses one of several specialties for further study; the three possible variants in 1958-1959 were astronomy, geology, and physics.

The relation between instructor and student progress was investigated in two ways: 1. The relation between C-21 instructors and their students' choice of variant in C-22. 2. The relation between C-21 instructors and the grades obtained by their students in C-22.

In regard to the question of selection of variant, five null hypotheses were tested:

(1) There is no difference in student choice of second semester variant on the basis of student's first semester instructor.

(2) There is no difference in student choice of second semester variant on the basis of student's sex.

(3) There are no differences among the patterns of progress test grades in C-21 for students choosing different variants in C-22.

(4) There are no differences among the patterns of High School Placement subtest scores for students choosing different variants in C-22.

(5) There are no differences among the patterns of A. C. E. subtest scores for students choosing different variants in C-22.

Hypotheses (1) and (2) were tested by chi square; hypotheses (3), (4), and (5) were tested by analysis of variance.

In regard to C-22 grade, one null hypothesis was tested:

(6) There is no difference in second semester student grade on the basis of first semester instructor. This hypothesis was tested by analysis of covariance, with High School Placement Total score as covariant.

Null hypotheses (2), (3), (4), and (5) were rejected. Analysis of the data showed that students of both sexes tended to take geology rather than astronomy or physics. Students were relatively more likely to enroll in astronomy or physics, however, if they were male, if they had done well on the C-21 progress tests (especially the tests on which the subject matter of astronomy or physics was heavily weighted), or if they had scored relatively high on the High School Natural Science, High School Mathematics, or A. C. E. Quantitative tests.

When data for instructors with small numbers of students were omitted, null hypothesis (1) was rejected. Separate analyses for male and female students indicated that instructors influenced female students only.

With the aid of background data obtained for instructors, some additional evidence for individual instructors' influence was found.

Null hypothesis (6) was accepted so it was concluded that if instructors influenced the subsequent behavior of their students, they did it mainly by influencing the choice of C-22 variant. That is, some instructors might have been able to overcome some of the reluctance of female students to choose astronomy or physics, variants which are probably more difficult and mathematical than geology.

Finally, small but significant negative correlations were found, in some cases, of C-22 section size with High School and A. C. E. scores. It was hypothesized that brighter students may be more willing to register for sections that meet at unpopular times.

Conclusion

In this study, there is evidence for instructional influence. The influence, appearing to consist mainly of the effect of some instructors on the choice of course of some of their female students, is specific rather than general. Thus, the present findings are consistent with those of Jacob, who concluded that some teachers exert an influence on some students. Because of the varied interests and abilities of students and teachers and because of the correspondingly large number of ways these interests and abilities can interact, the general effect of teaching may be almost impossible to isolate in a complex situation like C-2; it may not even exist. A general effect of teaching, however, may be more detectable in some differently designed course.

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APPENDIX A

1. Name____. 2. Age_____.

3. Marital status__________________. 4. Number of children_______.

5. Please list each degree received and which field of specialization the degree was in:

____

____

____

____.

6. Years teaching________________________.

7. Professional experience outside speciality (describe briefly):

____

____

____

____.

8. If you taught C-22 in 1958-1959, which variant did you teach (astronomy, geology, or physics)?___________________________.

9. Which variant would you prefer that C-22 students take (check one)?

(a) Astronomy

(b) Geology

(c) Physics

(d) Depends on student

10. How important do you think the subject matter you teach in C-21 is in terms of what students ought to learn in a physical science course (check one)?:

    (a) Important

    (b) About as important as could be expected

    (c) Relatively unimportant

11. To what extent are you interested professionally in astronomy? (check one):

    (a) Very interested

    (b) Moderately interested

    (c) Mildly interested

    (d) Neutral

    (e) Mildly uninterested

    (f) Moderately uninterested

    (g) Very uninterested

12. To what extent are you interested professionally in geology? (check one):

    (a) Very interested

    (b) Moderately interested

    (c) Mildly interested

    (d) Neutral

    (e) Mildly uninterested

    (f) Moderately uninterested

    (g) Very uninterested

13. To what extent are you professionally interested in physics? (check one):

    (a) Very interested

    (b) Moderately interested

    (c) Mildly interested

    (d) Neutral

    (e) Mildly uninterested

    (f) Moderately uninterested

    (g) Very uninterested

14. Comments.

BIOGRAPHICAL SKETCH

Charles T. Martoccia was born December 28, 1930 at Daytona Beach, Florida.

He attended the University of Virginia and was graduated with a B. A. degree in psychology from that school in 1952. He was elected to Phi Beta Kappa.

He spent four years in the United States Navy.

Later, attending the University of Florida, he received a M. A. degree in psychology February, 1958, and a Ph. D. degree in psychology August, 1960.

This dissertation was prepared under the direction of the chairman of the candidate's supervisory committee and has been approved by all members of that committee. It was submitted to the Dean of the College of Arts and Sciences and to the Graduate Council, and was approved as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August 13, 1960

Dean, College of Arts and Sciences

Dean, Graduate School

Supervisory Committee:

Richard J Anderson.

Chairman

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